

REVIEW ARTICLE

A systematic review of long-term care facility characteristics associated with COVID-19 outcomes

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Funding information

For three of the authors (White,
Grabowski, Mor), funding is
acknowledged from National Institute on
Aging under 3U54AG063546-02S2 (MPI V.
Mor, S. Berry).

Abstract

Background/Objectives: The coronavirus disease 2019 (COVID-19) pandemic has taken a disproportionate toll on long-term care facility residents and staff. Our objective was to review the empirical evidence on facility characteristics associated with COVID-19 cases and deaths.

Design: Systematic review.

Setting: Long-term care facilities (nursing homes and assisted living communities).

Participants: Thirty-six empirical studies of factors associated with COVID-19 cases and deaths in long-term care facilities published between January 1, 2020 and June 15, 2021.

Measurements: Outcomes included the probability of at least one case or death (or other defined threshold); numbers of cases and deaths, measured variably.

Results: Larger, more rigorous studies were fairly consistent in their assessment of risk factors for COVID-19 outcomes in long-term care facilities. Larger bed size and location in an area with high COVID-19 prevalence were the strongest and most consistent predictors of facilities having more COVID-19 cases and deaths. Outcomes varied by facility racial composition, differences that were partially explained by facility size and community COVID-19 prevalence. More staff members were associated with a higher probability of any outbreak; however, in facilities with known cases, higher staffing was associated with fewer deaths. Other characteristics, such as Nursing Home Compare 5-star ratings, ownership, and prior infection control citations, did not have consistent associations with COVID-19 outcomes.

Conclusion: Given the importance of community COVID-19 prevalence and facility size, studies that failed to control for these factors were likely confounded. Better control of community COVID-19 spread would have been critical for mitigating much of the morbidity and mortality long-term care residents and staff experienced during the pandemic. Traditional quality measures such as Nursing Home Compare 5-Star ratings and past deficiencies were not consistent indicators of pandemic preparedness, likely because COVID-19

[Correction added after first online publication on September 24, 2021. Keypoints have been changed.]

presented a novel problem requiring extensive adaptation by both long-term care providers and policymakers.

KEYWORDS

assisted living, COVID-19, long-term care, nursing homes

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has taken a disproportionate toll on long-term care facility residents and staff, who have accounted for roughly 1.4 million cases and 183,000 deaths—almost 40% of all U.S. deaths—as of mid-May 2021.¹ By early 2021, almost all U.S. nursing homes had experienced at least one COVID-19 case, and most (more than 80%) had experienced at least one death.²

The context of this tragedy, often referred to as a “perfect storm,”³ stems from the confluence of attributes of the virus, of long-term care residents, and of the setting. The SARS-CoV-2 virus that causes COVID-19 is airborne, can be spread asymptotically, and is particularly lethal for frail, older adults.⁴ A congregate setting exacerbates this risk. Nursing homes and assisted living communities (ALCs) house large numbers of residents, often in shared rooms, who need hours of intimate care that precludes social distancing. That the virus spreads asymptotically means that residents and staff can unwittingly serve as vectors of infection, triggering outbreaks that can quickly overwhelm a facility.⁵ This was especially problematic early in the pandemic when there was less known about asymptomatic transmission and testing resources were severely limited.

From the outset, policymakers and researchers have sought to identify actionable correlates of COVID-19 outbreaks and deaths in nursing homes and ALCs in order to find ways to mitigate the harm. Prior to the pandemic, 40% of nursing homes were cited with deficiencies in their infection control practices, making it the most frequently cited regulatory deficiency.⁶ However, whether these baseline measures of infection control practices and traditional quality indicators like the Nursing Home Compare 5-Star ratings correlate with a facility's success in preventing and controlling COVID-19 outbreaks has been uncertain. A flurry of empirical research has emerged to explore those correlations. In the absence of a systematic review, media reports have drawn mixed conclusions and have been unable to reconcile seemingly inconsistent findings. Indeed, one media story provocatively suggested that the explanation for why some facilities had better COVID outcomes “depends who you ask.”⁷

Key Points

- Larger size and location in an area with high COVID-19 rates were the strongest and most consistent predictors of COVID-19 outcomes.
- Outcomes varied by facility racial composition.
- More staff members increased outbreaks but more staff hours may have prevented deaths.

Why Does this Paper Matter?

Our results inform which policies might work; for example, large facilities in virus hotspots may benefit most from technical assistance and resources.

We fill this critical knowledge gap by systematically examining the evidence base on factors associated with COVID-19 cases and deaths in long-term care facilities. Our goal is to better inform practice and policy moving forward, both in this and future pandemics.

METHODS

We used PubMed to systematically search the literature for studies of factors associated with COVID-19 cases and deaths in long-term care facilities published between January 1, 2020 and June 15, 2021. Search terms included “SARS-CoV-2,” “COVID,” “coronavirus,” “nursing home,” “assisted living,” “long-term care,” and “skilled nursing.” Given the rapidly evolving nature of this literature, we supplemented our PubMed search with additional journal articles, preprints, and gray literature found as of July 15, 2021 through a combination of citation mining of existing papers, review of COVID-19 sections of key journals, and referral from content experts. We included all U.S. English language studies that empirically examined COVID-19 cases or deaths in long-term care facilities as an outcome and any area-, facility-, or unit-level factor as an independent variable. We excluded studies that did not contain quantitative empirical analysis, were not in English, or did not directly examine

COVID-19 cases or deaths. Because our focus was the long-term care environment and provider actions, we also excluded studies that solely examined resident-level predictors of COVID-19 outcomes.

Figure 1 summarizes the search process. During the PubMed search, two authors independently conducted all title, abstract, and full-text reviews, then discussed and agreed upon which studies to exclude at each stage. The initial PubMed search yielded 793 articles. Of these, 745 were excluded after title review, 14 after abstract review, and eight after full-text review, resulting in 26 articles for analysis. An additional 10 articles were identified through the secondary methods described above, yielding a total of 36 studies included for analysis. Only minor discrepancies among authors arose in terms of inclusions and exclusions, which were resolved through discussion.

To evaluate the quality of included studies, we examined key features of each study design. Due to limitations of available data and the need for rapid results as the pandemic unfolded, randomized trials or strong quasi-experimental designs enabling causal inference were not expected. Thus, quality was judged in terms of other aspects of internal validity (measurement of key variables, rigor of the statistical model and controls for key confounders, and underlying data quality) and external validity (whether the study was national, multi-state, single-state).

RESULTS

Table S1 summarizes the 36 studies that met our inclusion criteria.^{8–43} With one exception,²⁷ all studies used facility-level data and did not control for resident-level risk factors. Thirty-four studies examined nursing homes

only,^{8–28,31–43} one study included nursing homes and ALCs,²⁹ and one study examined ALCs only.³⁰ Nine were single-state studies;^{11,15,18,21–23,25,27,29} 14 were national studies;^{10,14,17,19,20,24,31,36–38,40–43} and the remainder were multi-state studies including between 3 and 30 states.

For data on COVID-19 cases and deaths in nursing homes, the vast majority of studies used one or both of two main data sources: the National Healthcare Safety Network (NHSN) data collected by the Centers for Disease Control and Prevention (CDC) and the Centers for Medicare and Medicaid Services (CMS) starting in May 2020 (with optional reporting of cases and deaths up to that point); and reports obtained from state websites. Five studies used data reported directly from nursing homes or ALCs.^{23,27,29,33,34} Most studies used data on COVID-19 cases reported prior to July 2020; 16 used data past this time period,^{10,13,14,20,23,26,29,31,34,37–43} with the latest study using data through April, 2021.^{37,38} As such, most of the studies do not take into account the widespread deployment of vaccines to facilities nationwide which began in mid-December 2020.

For other independent variables, LTCFocus, Nursing Home Compare, and Payroll-Based Journal staffing data were the most commonly used data sources for pre-pandemic measures of facility characteristics. The most common sources for area-level characteristics were census data, the Area Health Resources File, and the American Community Survey. County-level COVID-19 prevalence was drawn from statistics compiled by the *New York Times*, USAFacts.org, or the Johns Hopkins Coronavirus Resource Center.

Outcomes related to COVID-19 cases and deaths were measured in four main ways: (1) the probability of at least one case (an “outbreak”); (2) the probability of

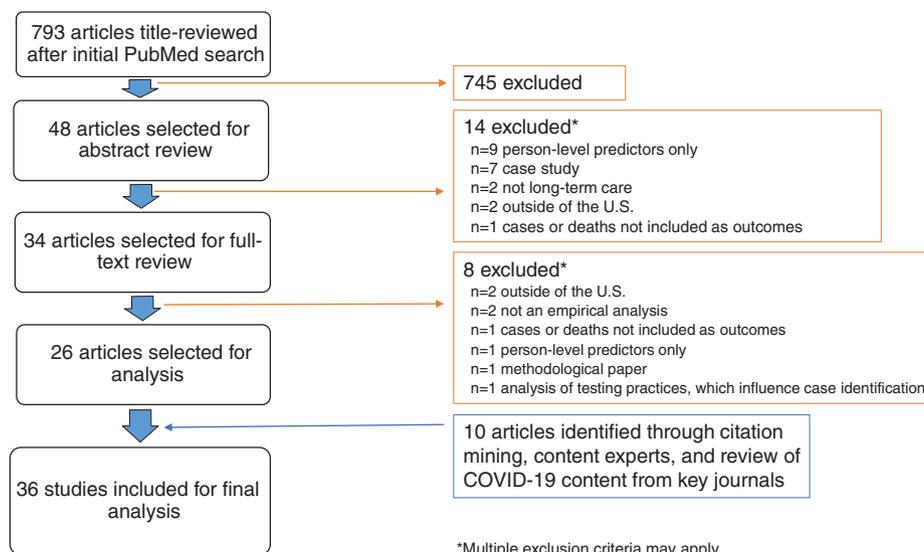


FIGURE 1 Summary of articles identified, included, and excluded during literature search

at least one death; (3) cumulative or weekly case counts or rates; and (4) cumulative or weekly death counts or rates. Earlier studies tended to use the probability of at least one case as the primary outcome, given skepticism about the accuracy of data on numbers of cases or deaths in the absence of widespread testing. Conceptually, this outcome emphasizes the ability to keep the virus from entering the facility, but became less interesting by fall 2020 when the vast majority of nursing homes had had at least one case. Later studies tended to examine multiple outcomes, including the number of deaths, with improved trust in the numbers due to increased testing. These additional outcomes provided a conceptually distinct perspective on a facility's ability to contain the virus once introduced. Most studies that examined counts of cases or deaths used cumulative measures. Six studies examined incident cases within a specific time window or stratified by time,^{11,20,24,38,39,43} and only four studies examined temporal variation.^{35,37,38,43}

Overall quality of the literature

The most robust studies either used national or multi-state data or collected rich primary data from a smaller number of facilities. Additionally, stronger studies controlled for geography and adjusted for multiple facility- and area-level covariates. Methodologically weaker studies were limited to a single state or a subset of facilities within one state (except for those involving primary data collection), presented only unadjusted analyses, and did not account for geographic variation. Table 1 summarizes the key quality-related attributes of each study.

The importance of community spread, facility size, and racial distribution

Across all studies, two findings stand out as most consistent and significant in magnitude. First, nursing homes located in areas (usually counties) with higher virus prevalence were at significantly higher risk for COVID-19 cases and deaths. None of the larger, more rigorous studies that included a direct measure of community COVID-19 prevalence or an area fixed effect failed to find a significant relationship, and usually their effects were substantially stronger than other variables in adjusted models.^{9,10,12,14,16,17,19,20,24,26–28,30,31,33,35,36,40,42,43} Second, almost as consistent was the finding that larger facilities had a higher probability of any outbreak and more cases than smaller facilities.^{9,11,12,18–21,26,28,30–35,43}

Sixteen studies examined whether the racial composition of a facility's resident population was related to COVID-19 outcomes. Fourteen of those used data from

spring 2020 to early fall 2020^{8,9,13,20,22,24,26,28,30,31,33,35,41,43} and all found that facilities with a higher proportion of Black and Hispanic residents had higher rates of adverse outcomes. Two studies examined mortality rates using later data and found distinct temporal variation: nursing homes with a high proportion of Black and Hispanic residents had more deaths through summer 2020, but predominantly White nursing homes had more deaths in late 2020 and early 2021 when COVID-19 rates surged in the upper Midwest and rural states of the West.^{37,38} Facility size and community characteristics including virus prevalence, population density, urbanicity, and social vulnerability index explained much of the variation by race.^{20,23,26,31,43}

The relationship between COVID-19 outcomes and quality measures

Many of the studies ($n = 16$) directly examined the relationship between the Nursing Home Compare overall 5-Star rating and COVID-19 outcomes.^{8,9,11,12,14–16,19,20,22,24–26,35,42,43} Across the vast majority of these studies, including all but one of the larger studies, using multiple data sources, no practically meaningful or statistically significant relationship was found between the overall 5-Star rating and COVID-19 outcomes. In contrast, only five studies found that higher star ratings were significantly associated with fewer COVID-19 cases, and four of these were single-state studies with limited generalizability,^{11,18,22,24} finding small effect sizes that could be attributable to inadequate controls for confounding. Most importantly, two California-only studies^{18,22} did not control for community virus prevalence, and a West Virginia study¹¹ included only 14 facilities with outbreaks, one of which had no 5-Star rating.

The remaining study that found an association between 5-Star ratings and COVID-19 outcomes, conducted by CMS and its team that developed the 5-star ratings, used national data and controlled for key confounders, but used an unusual denominator for their outcome measures: cumulative resident incidence and mortality and the number of weeks in the top decile of resident incidence.⁴² The denominator for the cumulative measures was the resident census as of January 2021 rather than the typical baseline measure, with an offset term to account for average resident census starting only in May 2020. Thus, the incidence and mortality rates were likely inflated in exactly those nursing homes that experienced a larger drop in occupancy due to COVID-19 deaths or decreased admissions, particularly those that experienced their worst outbreaks in March and April 2020, before NHSN data collection began.

TABLE 1 Summary of key evaluation criteria

Study	States (n)	NH or ALC sample size (n)	Time period for COVID-19 cases	COVID-19 data sources	Key outcomes			Area-level control	Nursing home compare measures
					Probability of outbreak	Cases	Deaths		
Konetzka ⁴⁶	12	5527 NHs	Through May 13, 2020	State reports	X	X		X	
Abrams et al. ⁹	30	9395 NHs	Through May 11, 2020	State reports	X	X	X	X	
White et al. ³³	26	341 NHs/3016 NHs	Through May 4, 2020	State reports & provider data	X	X	X	X	
Chatterjee et al. ¹²	23 + DC	8943 NHs	Through April 29, 2020	State reports	X			X	
Gorges et al. ¹⁹	50 + DC	13,167 NHs	Through June 25, 2020	NHSN	X	X	X	X	
Figueroa et al. ¹⁶	8	4254 NHs	Through June 30, 2020	State reports	X	X	X	X	
He et al. ²²	1 (CA)	1223 NHs	Through June 2, 2020	State reports	X	X	X	X	
Harrington et al. ²¹	1 (CA)	1091 NHs	Through May 4, 2010	State, county, and media reports	X			X	
Li, Temkin-Greener et al. ²⁵	1 (CT)	215 NHs	Through April 16, 2020	State reports	X	X	X	X	
Dean et al. ¹⁵	1 (NY)	355 NHs	Through May 31, 2020	State reports	X	X	X	X	
Gandhi et al. ¹⁷	49	13,398 NHs	Through May 24, 2020	NHSN	X	X	X	X	
Shi et al. ²⁷	1 (MA)	1 NH	Mar 16 to May 8, 2020	NH testing data	Resident-level outcome: incident COVID-19	X	N/A (1 NH)	X	
Shen et al. ²⁶	18	7154 NHs	Through July 10, 2020	State reports		X	X	X	
Temkin-Greener et al. ³⁰	7	3994 ALCs	Through May 29, 2020	State reports	X	X	X	N/A	

TABLE 1 (Continued)

Study	States (n)	NH or ALC sample size (n)	Time period for COVID-19 cases	COVID-19 data sources	Key outcomes				Nursing home compare measures
					Probability of outbreak	Cases	Deaths	Adjusted analysis	
Cronin et al. ¹⁴	50 + DC	15,115 NHs	Through September 13, 2020	NHSN and state reports	X	X	X	X	X
Li, Cen, et al. ²⁴	50 + DC	12,576 NHs	May 25 to May 31, 2020	NHSN	X	X	X	X	X
Unruh et al. ³²	3 (CT, NJ, NY)	1162 NHs	Through mid-April, 2020	State reports		X	X		
Bui et al. ¹¹	1 (WV)	123 NHs	Through June 11, 2020	State reports	X		X	X	X
Sun et al. ²⁸	3 (MA, GA, NJ)/1 (CA)	1146 NHs / 1021 NHs	Through late April/early May, 2020	State and local reports	X		X	X	X
Chen, Chevalier, et al. ³⁵	21 + DC/50 + DC	6337 NHs / 13,165 NHs	Mar 13 to May 31, 2020	NHSN and state reports		X	X	X	X
Gopal et al. ¹⁸	1 (CA)	713 NHs	Through May 1, 2020	State report	X	X	X	X	X
Telford et al. ⁴⁵	1 (GA)	17 NHs, 7 ALCs	Through July, 29, 2020	NH testing data		X			N/A (1 county)
LeRose et al. ²³	1 (MI)	103 NHs	Through August 2020	State report		X	X		
Braun et al. ¹⁰	50 + DC	11,470 NHs	Through July 2, 2020	NHSN		X	X	X	X
Sugg et al. ³⁶	50 + DC	13,709 NHs	Through June 30, 2020	NHSN		X	X	X	X
Zimmerman et al. ³⁴	20	219 NHs / 177 NHs / 215 NHs	January 20, 2020 to July 31, 2020	NHSN and primary data		X	X	X	X

(Continues)

TABLE 1 (Continued)

Study	States (n)	NH or ALC sample size (n)	Time period for COVID-19 cases	COVID-19 data sources	Key outcomes			Area-level control	Nursing home compare measures
					Probability of outbreak	Cases	Deaths		
Gorges et al. ²⁰	50 + DC	13,312 NHs	Through September 13, 2020	NHSN		X	X	X	
Chen, Yun, et al. ¹³	NR	3008 NHs	Through October 11, 2020	NHSN	X		X		
Kumar et al. ³⁷	50 + DC	11,718 NHs	June 1, 2020 to December 27, 2020	NHSN		X	X	X	
Travers et al. ³¹	50 + DC	11,587 NHs	Through July 19, 2020	NHSN	X	X	X		
Williams et al. ⁴²	50 + DC	14,693 NHs	Through January 10, 2021	NHSN	X	X	X	X	
Weech-Maldonado et al. ⁴¹	50 + DC	12,914	Through October 25, 2020	NHSN		X	X		
Ryskina et al. ⁴⁰	50 + DC	11,585	Through August 2020	NHSN	X		X		
Gilman and Bassett ³⁸	50 + DC	13,820	May 25, 2020 to April 18, 2021	NHSN		X	X	X	
McGarry et al., 2021 ³⁹	NR	7154	June 1, 2020 to September 27, 2020	NHSN	X	X	X	X	
Cai et al. ⁴³	50 + DC	13,123	June 7, 2020 to August 23, 2020	NHSN	X	X	X	X	

Note: Studies using national data that did not explicitly report number of states are assumed to represent 50 states plus Washington, D.C. Abbreviations: ALC, assisted living community; NH, nursing home; NHSN, National Healthcare Safety Network COVID-19 module for long-term care facilities; NR, not reported.

Despite this likely inflation, the magnitudes of the associations were small. Similarly, the star ratings measures were from January 2021, meaning that outcomes during COVID were likely predicting star ratings and not the other way around.

Some studies examined 5-Star ratings for one or more of the overall rating's three domains: inspections, staffing, and quality measures.^{8,12,14,16,18,19,21,33,36} Only one study found a significant relationship between higher quality measures rating and fewer cases,⁴² and the majority of studies found no association or inconsistent relationships between COVID-19 outcomes and the staffing or inspections ratings.^{8,12,33,36} The CMS study described above found significant relationships for both staffing and inspections, with the same caveats noted above.⁴² One California study without geographic controls found that nursing homes with a 5-star staffing rating were less likely to have any COVID-19 cases,²¹ and another small study based on early data found that nursing homes with 4 or 5 Stars in staffing had a lower probability of having at least 30 cases,¹⁶ but the majority of studies with adequate controls found no association between COVID-19 outcomes and the staffing star ratings. Similarly, although one study found that more stars in the inspection rating was associated with fewer deaths,¹⁴ most studies found no association.

Four studies examined prior infection control inspection citations specifically,^{9,13,26,33} given their direct relevance. However, none of the four studies found that these prior citations were predictive of COVID-19 cases or deaths. One small study from 1 Georgia county found that facilities with fewer cases had better practices related to personal protective equipment (PPE) and social distancing, but no differences in other infection control practices, though the sample was subject to selection bias since facilities with low case counts were not included.²⁹

The relationship between COVID-19 outcomes and staffing

Several studies examined staffing hours per resident-day, measured just prior to the pandemic, as a predictor of COVID-19 outcomes.^{13,15,19,25,36} A national study found that, conditional on having any outbreak, nursing homes with more CNAs and total nurse staffing had fewer cases and deaths;¹⁹ a Connecticut study found the same for RNs.²⁵ These effects were small in magnitude relative to the effect of facility size or county virus prevalence. A New York study found higher CNA staffing, regardless of outbreak status, and the presence of labor unions, to be associated with fewer deaths.¹⁵ Other studies confirmed the protective effect of higher total nurse staffing once an

outbreak occurred, with some inconsistencies by staff type.^{13,36}

In contrast, there is no evidence that having more staff prevented an initial outbreak. Indeed, several studies underscored the role that staff played in inadvertently bringing the virus in to the facility. One study found that nursing homes with a larger number of unique staff members—even when controlling for hours of care per day—had more COVID-19 cases.³⁹ Other studies found that units of a nursing home whose staff lived in ZIP Codes with higher COVID-19 prevalence were more likely to have an outbreak,²⁷ that characteristics of staff neighborhoods were more predictive of nursing home deaths than nursing home location characteristics;²⁶ and that staff movement between facilities was highly predictive of resident COVID-19 cases.³⁵

The relationship between COVID-19 outcomes and nursing home organizational factors

Given longstanding policy and research interest in nursing home ownership structures and payer mix, many studies included characteristics, such as for-profit status and Medicaid census. Most studies did not find these factors to be significant or meaningful in magnitude.

Two studies directly examined the association between private equity ownership and COVID-19 outcomes.^{10,17} Neither found that nursing homes owned by private equity firms had worse COVID-19 outcomes; in fact, results of the more rigorous study suggested that private-equity-owned nursing homes had fewer cases as well as better access to PPE and testing.¹⁷ One study found that “Greenhouse” facilities had lower rates of both cases and deaths relative to facilities in the same area, consistent with the fact that Greenhouse facilities are small and tend to use staff for multiple purposes, limiting the number of staff entering and exiting a facility daily.³⁴ Finally, one study found that nursing homes in areas of high social deprivation were more at risk for COVID-19 cases and deaths; however, this study did not control for other key risk factors.²³

DISCUSSION

We reviewed the evidence from 36 studies of nursing home and ALC attributes associated with COVID-19 cases and deaths. We found the largest and most consistent predictors of COVID-19 cases and deaths to be community prevalence of COVID-19 and larger facility size, which relates to the amount of foot traffic coming and

going from that community as well as ease of transmission within a facility. Studies that failed to control for these two factors were therefore likely confounded. Outcomes were disparate by the racial composition of the resident population, with facilities serving predominantly Black and Hispanic residents being hit hardest in the spring and summer of 2020, and predominantly White facilities subject to surges in the late fall and early winter of 2020. Facility size and community characteristics including virus prevalence partially explained the variation by race. Baseline nurse staffing levels were not consistently associated with the probability of having any outbreak, though more robust studies found that better-staffed facilities had fewer deaths and smaller case counts once an outbreak occurred. Other nursing home characteristics, such as Nursing Home Compare 5-Star ratings, ownership, and prior infection control citations did not have consistent, meaningful associations with COVID-19 outcomes.

The current evidence base is subject to several limitations. First, most studies to date have examined risk factors and outcomes at the facility and community levels. Although studies examining resident-level risk factors have begun to emerge,^{4,27,44} those data are still limited, and it will be important in future work to examine resident- and staff-level risk factors in conjunction with facility-level factors. Second, each of the data sets used in the included studies has limitations; the NHSN data, for example, are missing many cases prior to May 2020, and LTCFocus data are several years old—but our conclusions hold across studies using varied data sources. Third, the vast majority of studies used data only through early fall 2020, missing the November–December 2020 surge that triggered some of the worst outbreaks of the pandemic.² Finally, almost all of the studies in the review were cross-sectional. More work is needed to establish causal connections and assess temporal trends.

The results of our review have direct implications for policy and practice. The overwhelming importance of community COVID-19 prevalence in predicting long-term care cases and deaths suggests that mitigation policies should not solely focus on facility actions. Prior to the existence of effective vaccines, the single most important thing that policymakers could have done to mitigate the crisis in long-term care would have been to effectively use public health measures to stem community spread. At the same time, policymakers could have prioritized the highest-risk facilities for PPE distribution, access to early surveillance testing to identify outbreaks,⁴⁵ and assistance with coordinating emergency staffing reserves. Well into the pandemic, nursing homes were reporting widespread shortages of these critical resources.^{46–48} The US Government Accountability Office concluded that CMS largely ignored a September 2020 report by their own Coronavirus Nursing Home Commission that

recommended further investment in system-based measures such as PPE, workforce, and rapid testing.⁴⁹

Unfortunately, in spring and summer of 2020, CMS pushed policies such as emergency inspections for infection control violations, predicated on the assumption that facilities could control outbreaks independent of community prevalence. CMS cited its earlier analysis of NHSN data that COVID-19 cases were associated with the 5-Star ratings, an analysis that was never released.⁵⁰ Subsequently, CMS implemented a program to financially reward or fine facilities based on their COVID-19 cases and deaths.⁵¹ Our review suggests that such policies were misguided, given that the strongest predictor of COVID-19 outcomes was facility location. Anecdotal and qualitative evidence suggests that such policies may have had the inadvertent effects of diverting critical resources away from facilities most in need,⁵² and shouldering administrators with undue administrative and regulatory burden at a time when they needed to focus on crisis management.⁵³

The lack of consistent relationships between COVID-19 outcomes and ownership structure departs from past research which has found these factors to be associated with quality. Although for-profit providers have been shown to employ fewer nursing staff, they also have organizational attributes which may have positioned them better than small, independently owned facilities to respond to the pandemic. Larger chains could centralize decision-making to help reduce administrative burden for local facility leaders, streamline responses to changing guidance and regulations, maintain tracking systems, leverage connections for procurement of PPE and testing supplies, and facilitate communication with federal, state, and local health entities.

One exception to the lack of effective strategies by facilities themselves is staffing. A large literature links the levels of direct-care staffing to nursing home quality, especially in the case of registered nurse (RN) staffing.^{54,55} Staffing may have taken on even greater importance under pandemic conditions, as having adequate staff is a prerequisite for implementing the measures now considered best practices in trying to control an outbreak. The evidence from our review supports a positive (if small/inconsistent) role of staffing in handling an outbreak once it occurred.

Our results do not exonerate long-term care providers from implementing rigorous infection control practices or imply that there are not concerns regarding care quality. Rather, the evidence suggests a widespread and unique challenge, especially in the face of inadequate supply chains for PPE and rapid testing. COVID-19 has been a devastating, once-in-a-generation problem requiring new organizational and clinical processes to contain an airborne, asymptotically spread virus that is particularly lethal to the population nursing homes and ALCs serve. These new processes include implementing

complex isolation and quarantine protocols; time- and resource-intensive testing procedures; daily screenings of staff, residents, and visitors; new admission procedures; PPE procurement and management; restructuring of the physical environment to allow for social distancing; new communication processes with families; and a massive vaccination campaign. They also involved adherence to rapidly evolving local, state, and national guidance. The challenges with adapting to these new tasks likely reflect lack of flexibility in the current structure of the industry as well as the unprecedented nature of the pandemic.

Studies of the tragedy of the past year have provided critical evidence to inform future emergency preparedness in long-term care. For the rest of this pandemic, and for future public health emergencies, long-term care facilities must be recognized as integral components of the health care system and prioritized for assistance and resources as needed. Despite the need for long-term care providers to improve, our review revealed little that providers could have done to prevent an outbreak when in a hotspot. The fate of residents and staff of long-term care facilities is inextricably linked to the fate of the communities in which they are located. Policies to address future crises need to recognize these linkages and provide a more integrated response.

CONFLICT OF INTEREST

The authors declare no conflicts of interest with the work.

AUTHOR CONTRIBUTIONS

All authors contributed significantly to the work, in initiating the project (R. Tamara Konetzka, Vincent Mor, David C. Grabowski); conducting the search (Elizabeth M. White, Alexander Pralea); drafting the manuscript (R. Tamara Konetzka); and critical revision of the manuscript (Elizabeth M. White, David C. Grabowski, Vincent Mor).

SPONSOR'S ROLE

None.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Table S1 Table of Evidence Summarizing Studies of COVID-19 Outcomes in U.S. Nursing Homes and Assisted Living Communities

How to cite this article: Konetzka RT, White EM, Pralea A, Grabowski DC, Mor V. A systematic review of long-term care facility characteristics associated with COVID-19 outcomes. *J Am Geriatr Soc*. 2021;69(10):2766-2777. doi:10.1111/jgs.17434